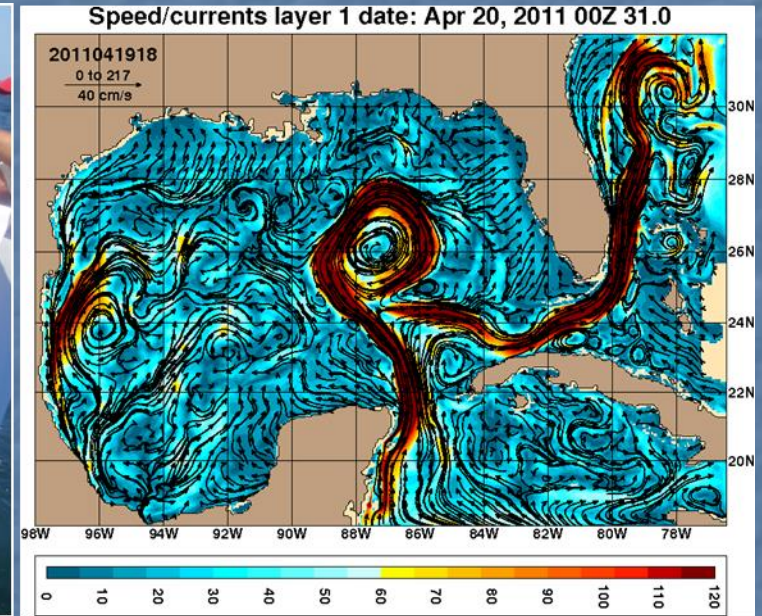
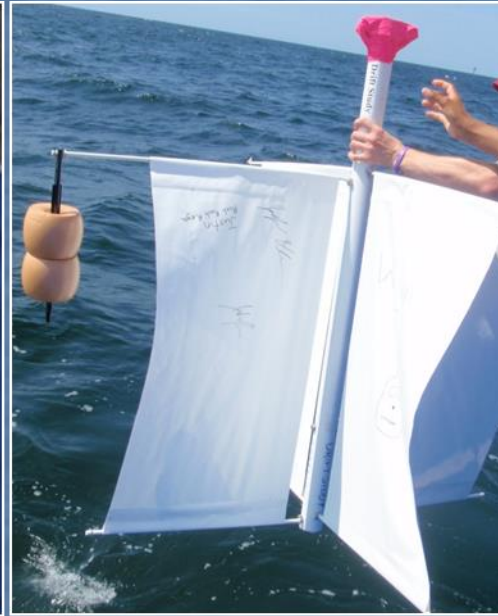


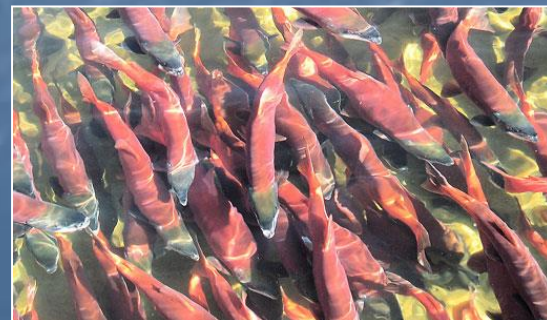
# Inferring the movements of marine animals from satellite telemetry, Lagrangian drifters and ocean circulation models



Dr. Nathan F. Putman  
Southeast Fisheries Science Center  
National Academy of Science, NRC Research Associate  
May 29, 2014

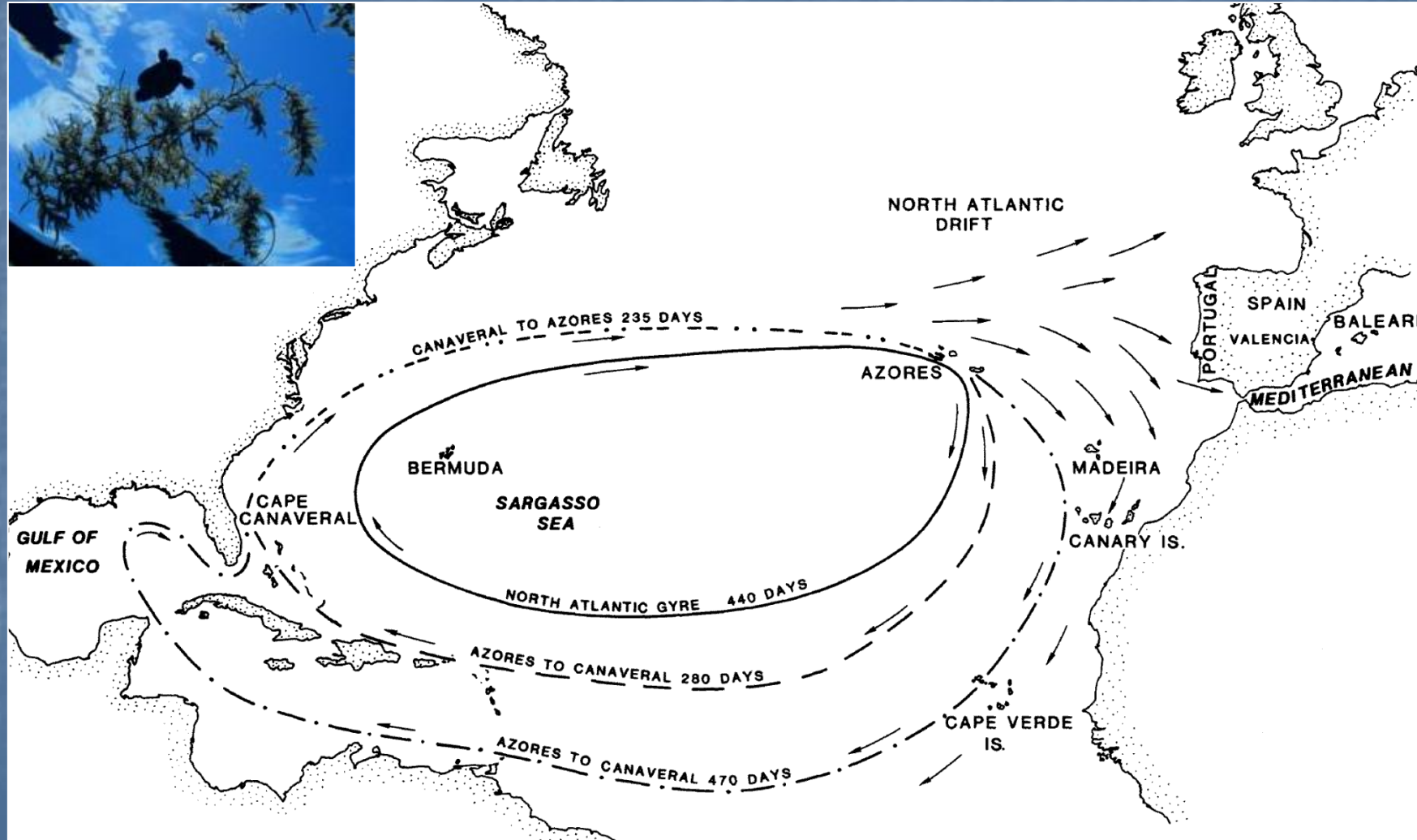


# Long-distance movements are common to diverse marine animals



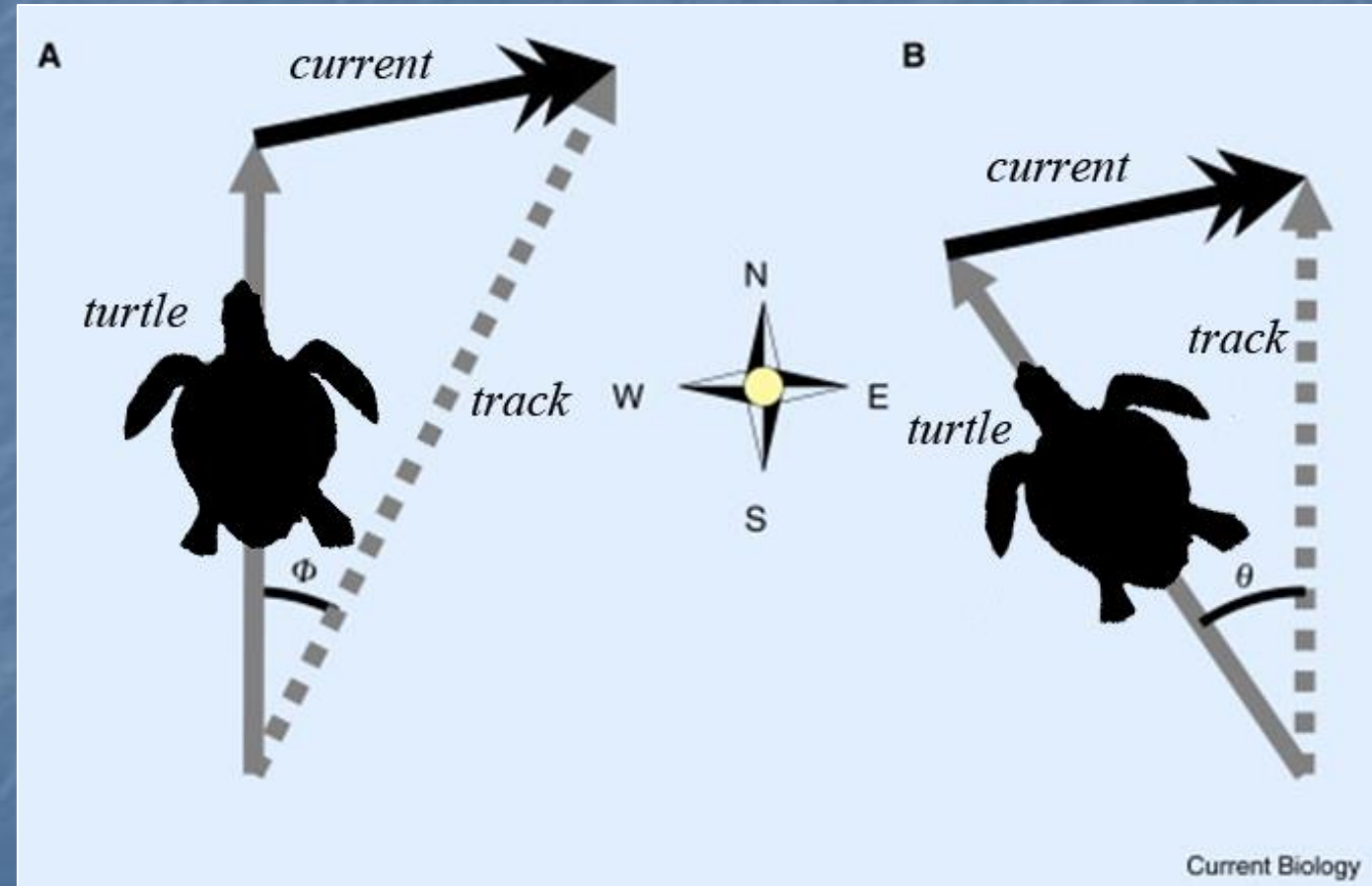


# The oceanic migration of juvenile sea turtles: "the lost years"



# Movement of animals in the ocean

The path of a marine animal is a combination of its swimming velocity and that of the ocean currents.



Modified from Chapman et al. 2011



# Tracking juvenile turtles in the Gulf of Mexico



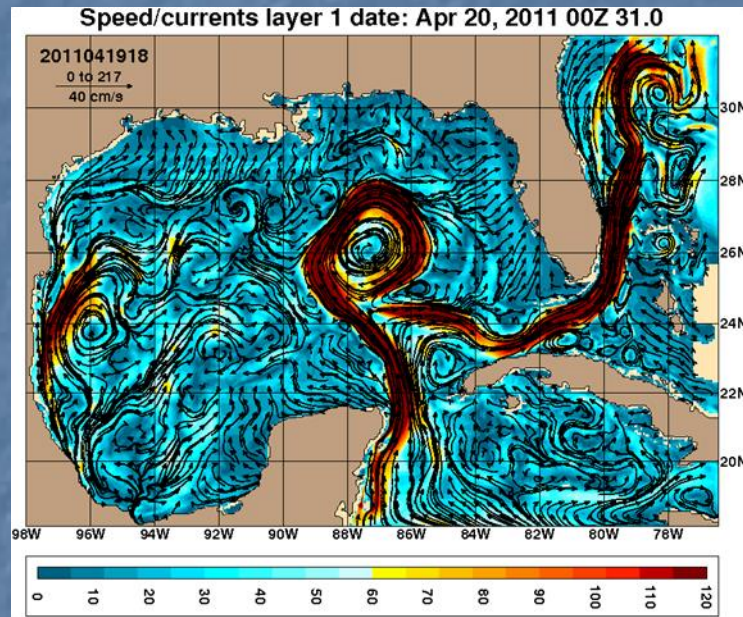
Dr. Kate Mansfield

Formerly at SEFSC, currently  
professor at University of Central  
Florida

# Virtual particle tracking with ICHTHYOP in the Hybrid Coordinate Ocean Model



**HY  
COM**



## Gulf of Mexico HYCOM

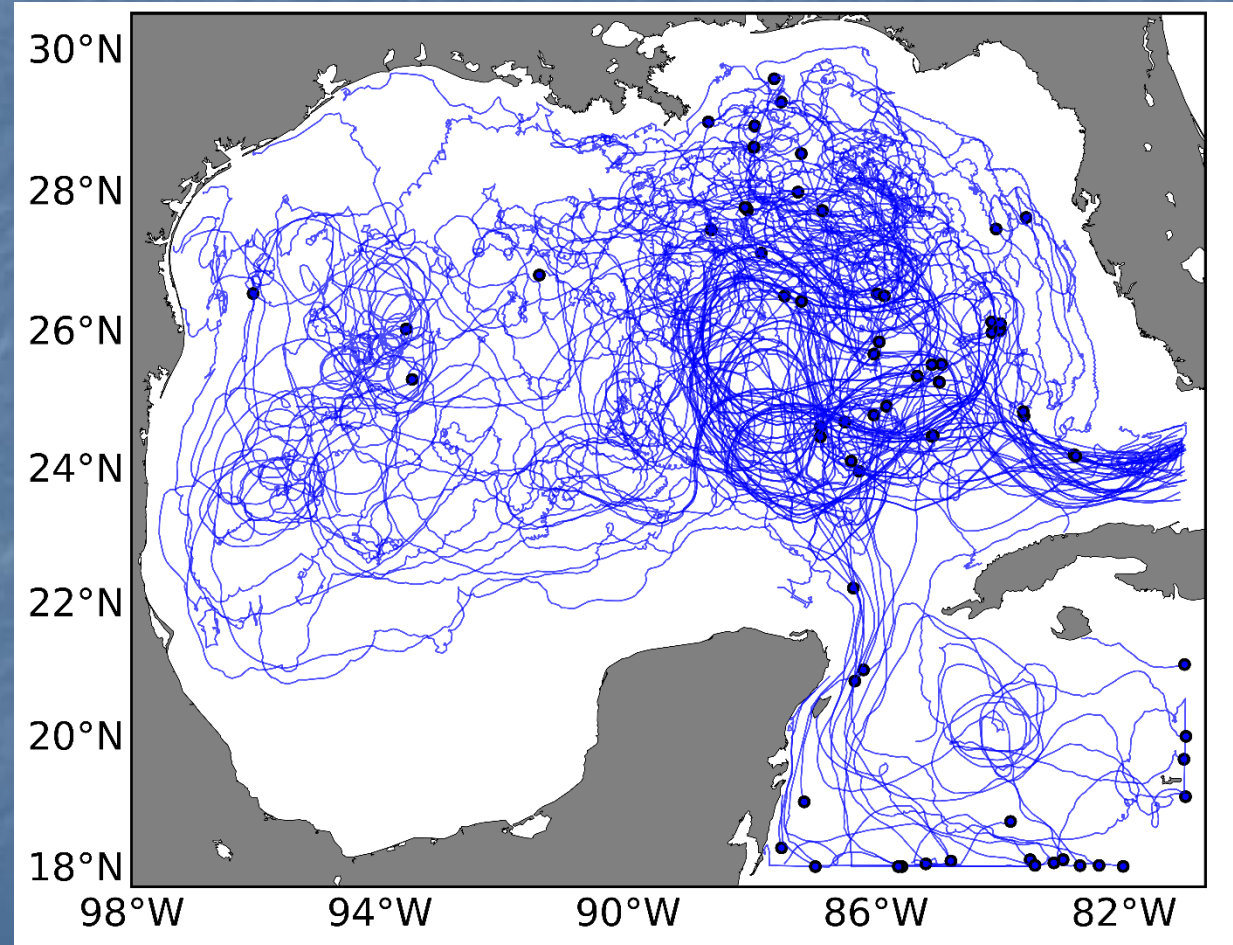
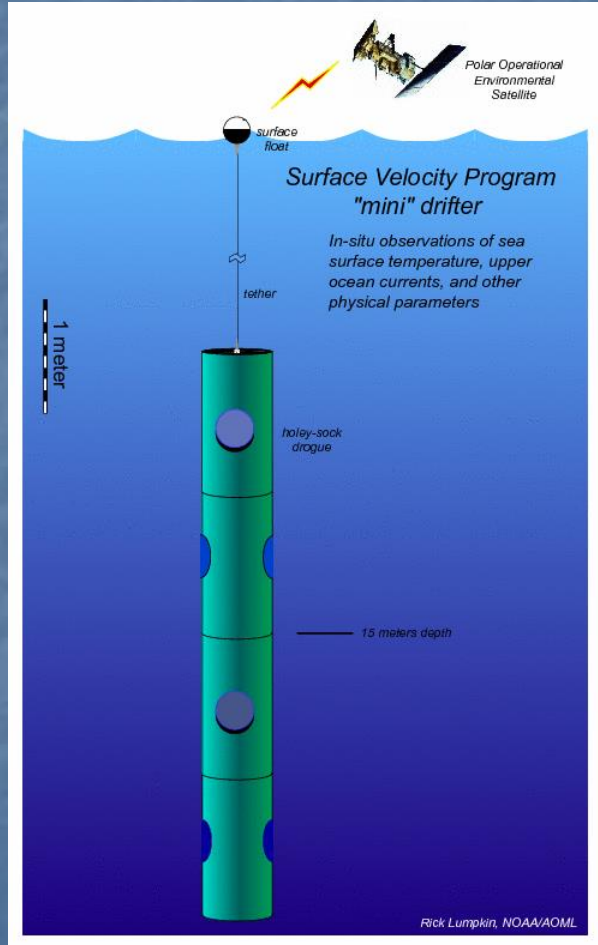
- 0.04° grid resolution
- Hourly snap shots at 0 m
- Data assimilation

## ICHTHYOP

- Runge-Kutta 4<sup>th</sup>-Order Method for computing particle movement through velocity fields

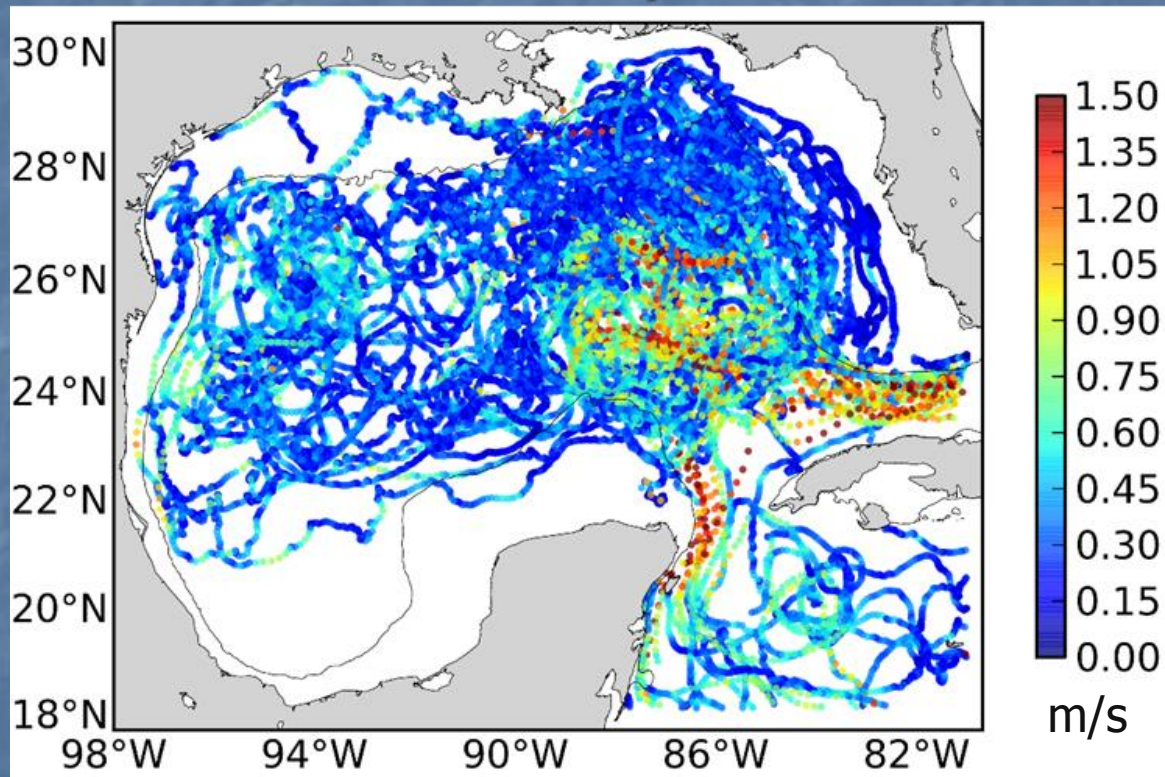


# AOML Drifters in Gulf of Mexico (2009 – 2013)

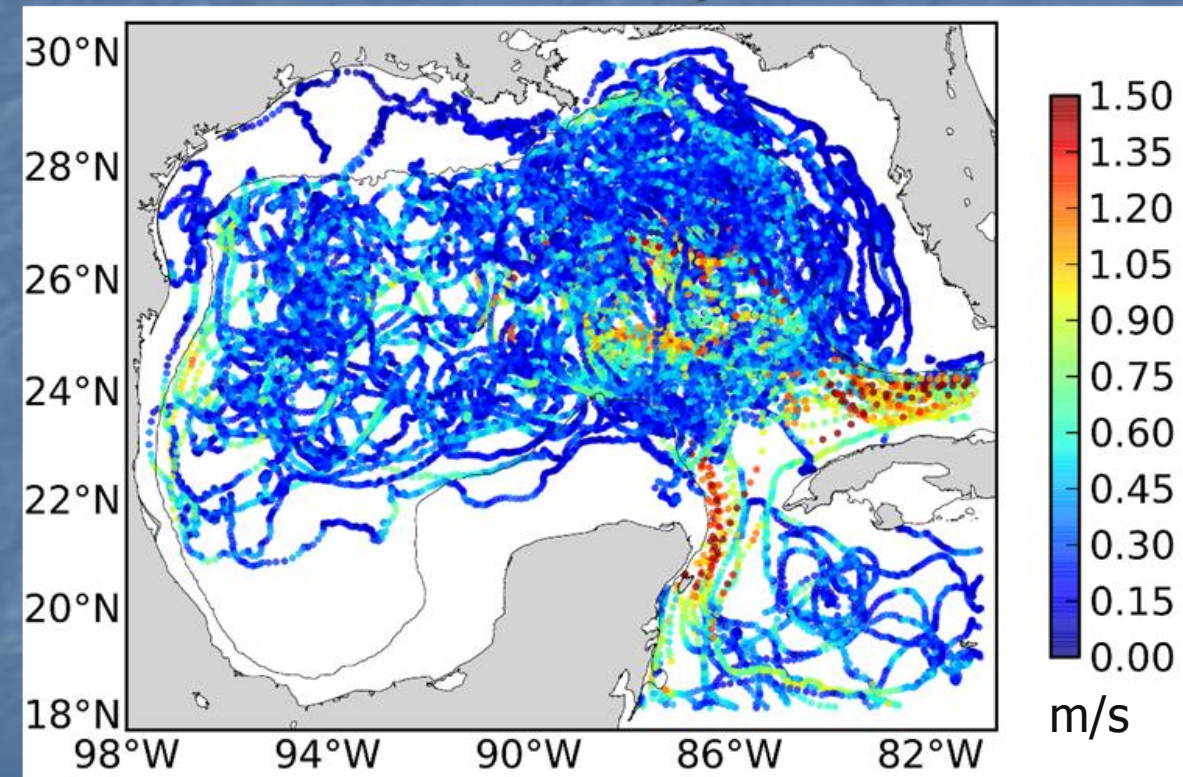


# Difference between AOML drifters and HYCOM Surface Velocity

## Track speed

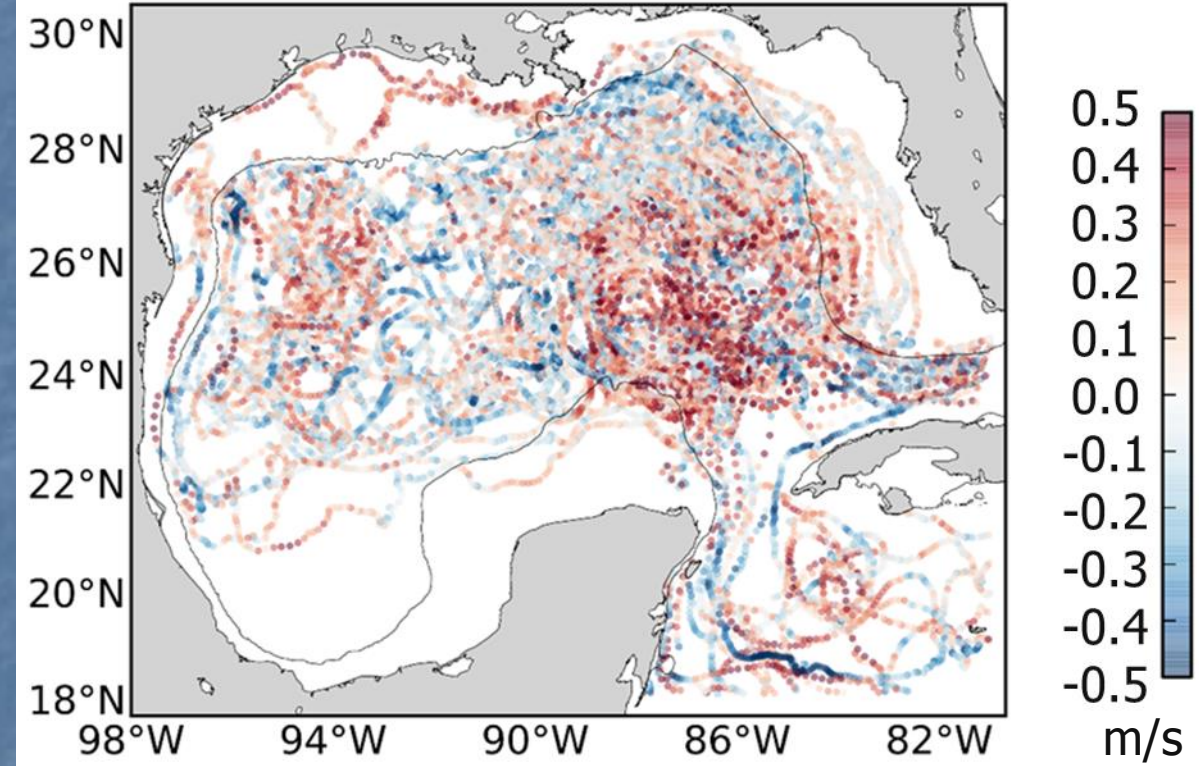
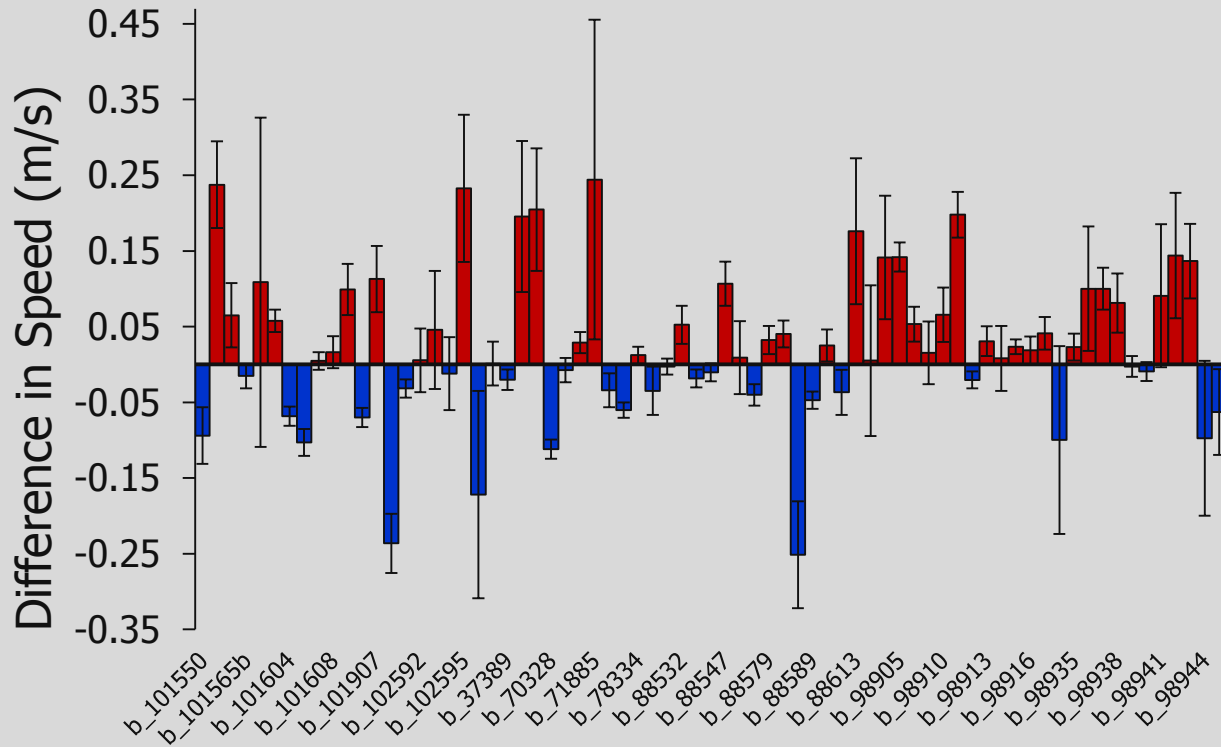


## Particle speed



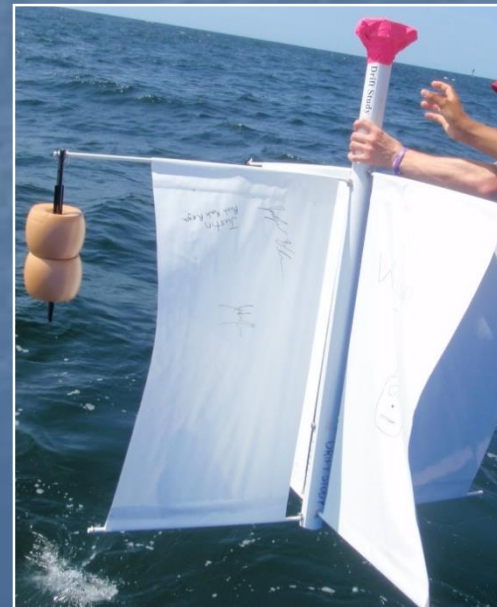


# Difference between AOML drifters and HYCOM Surface Velocity



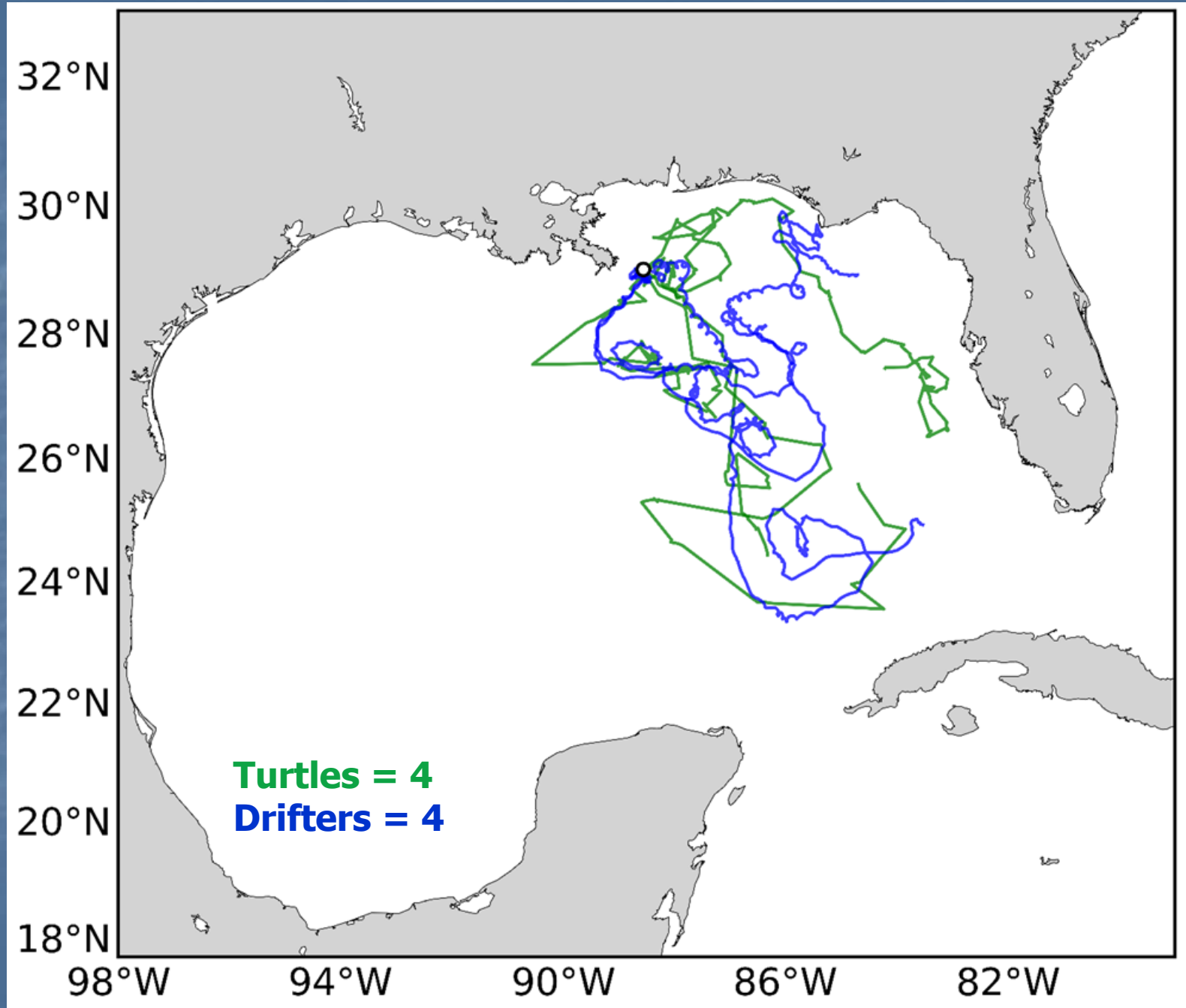
Mean speed difference = 0.001765 m/s  
N = 30,361 six-hourly positions

# Tracking juvenile turtles and drifters in the Gulf of Mexico

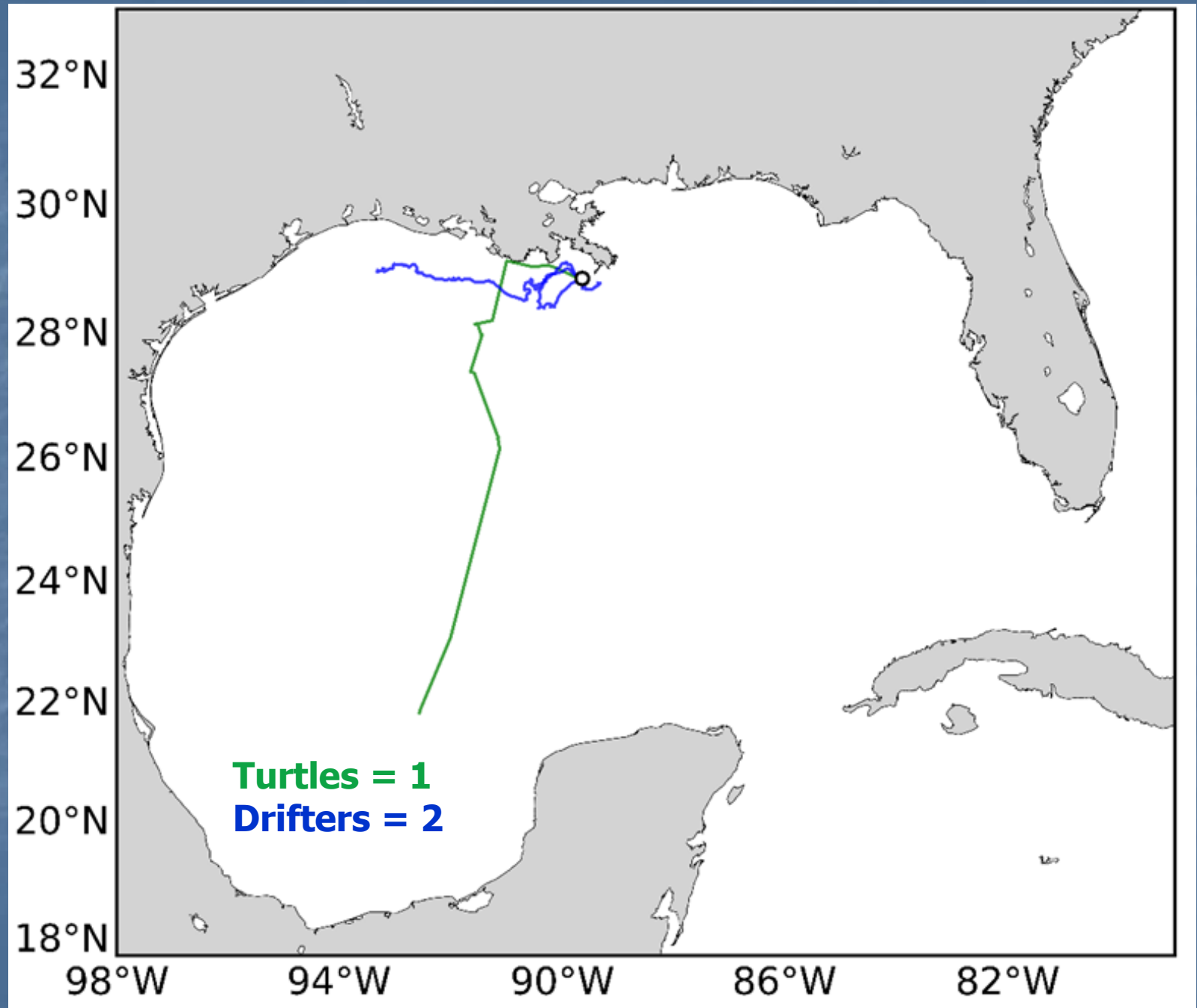




# Tracking results of turtles and drifters: release 1

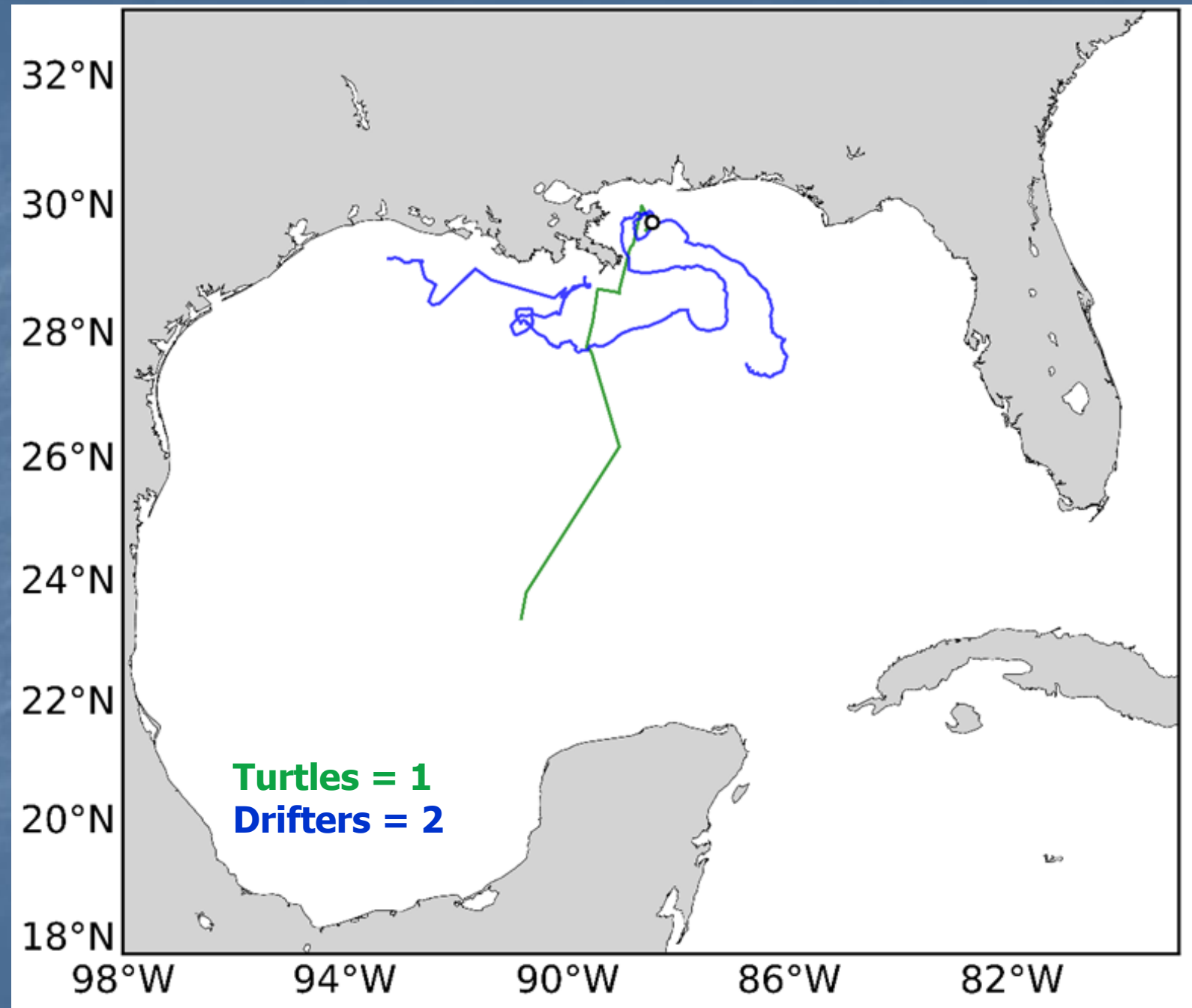


# Tracking results of turtles and drifters: release 2

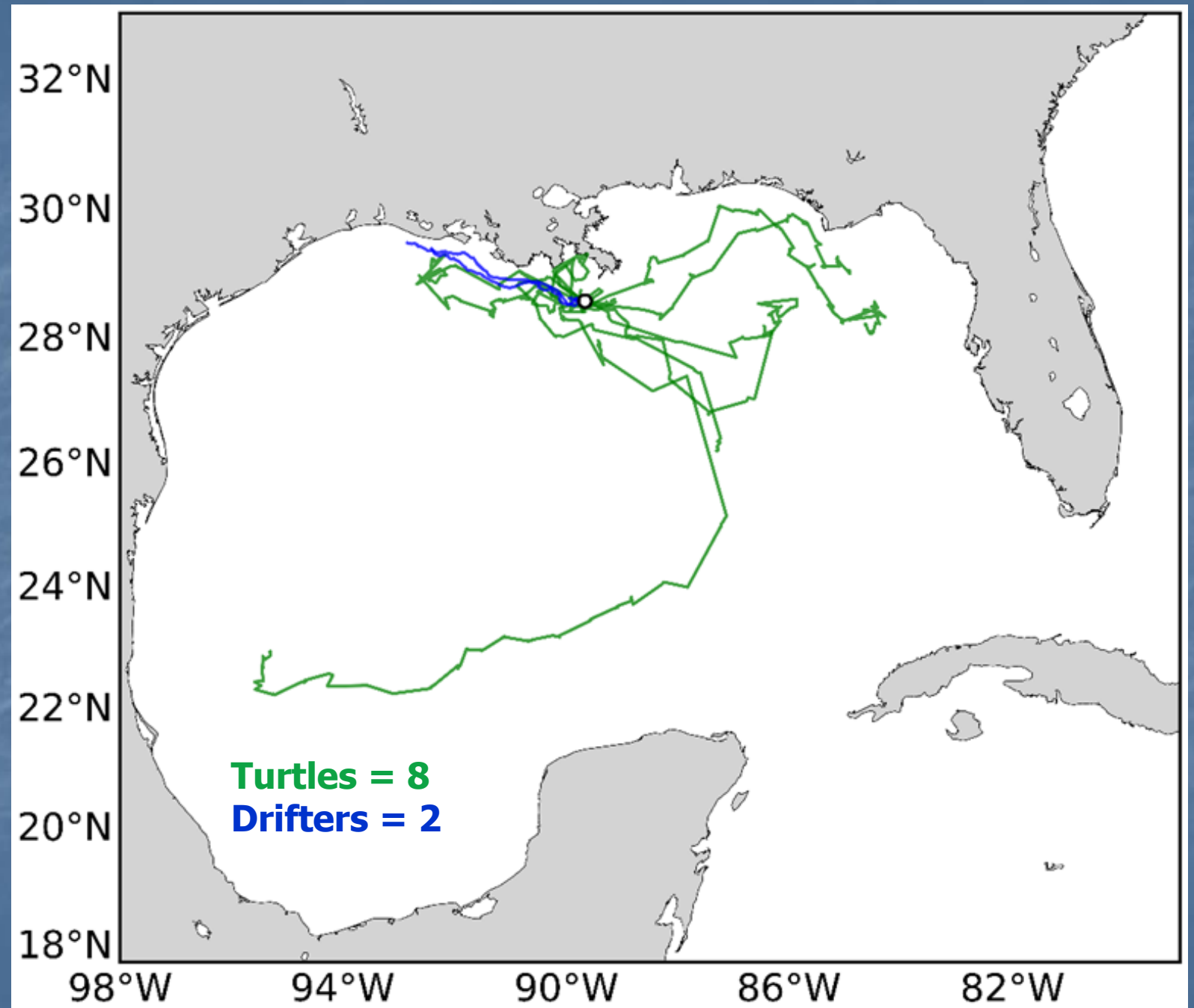




# Tracking results of turtles and drifters: release 3

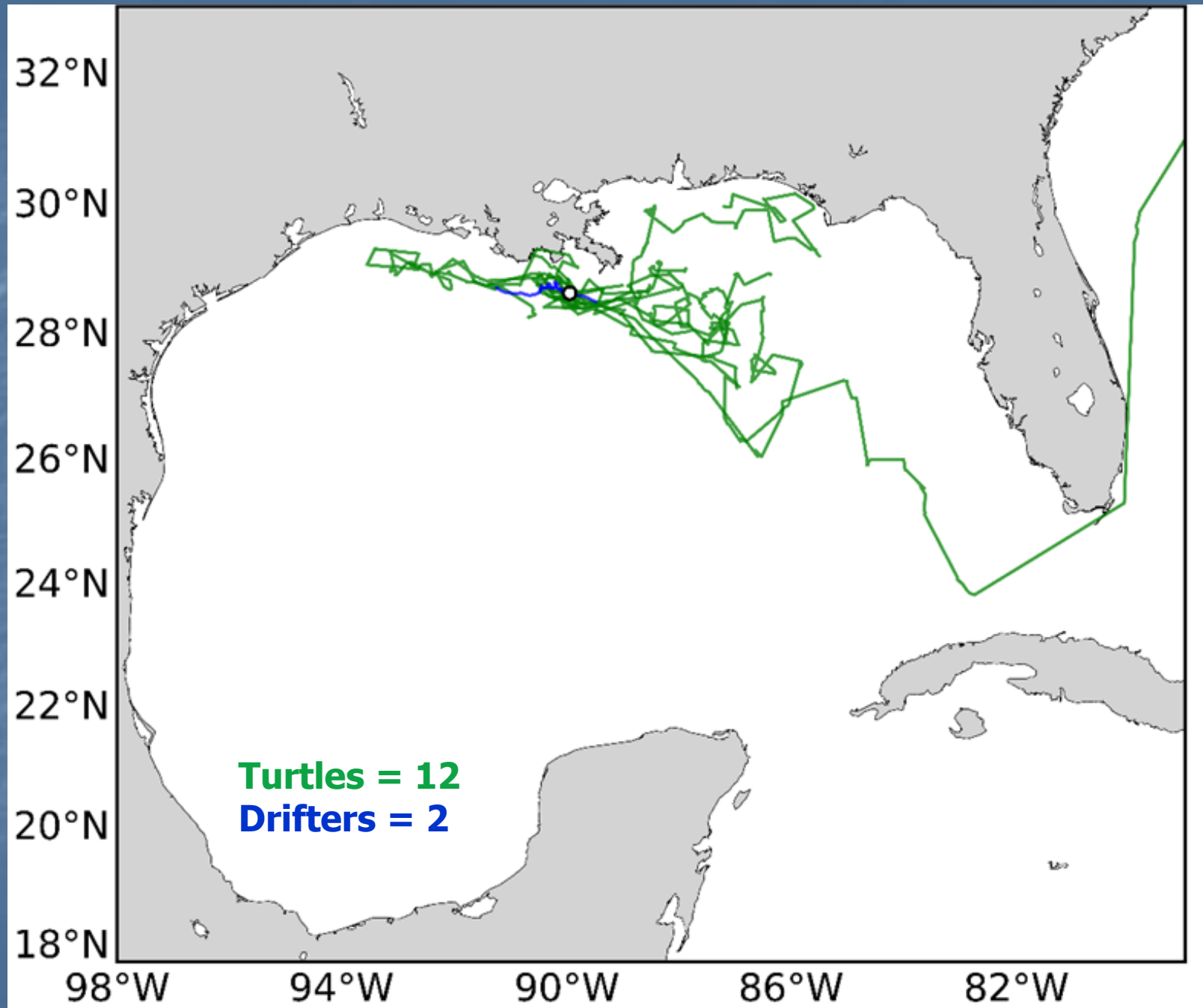


# Tracking results of turtles and drifters: release 4

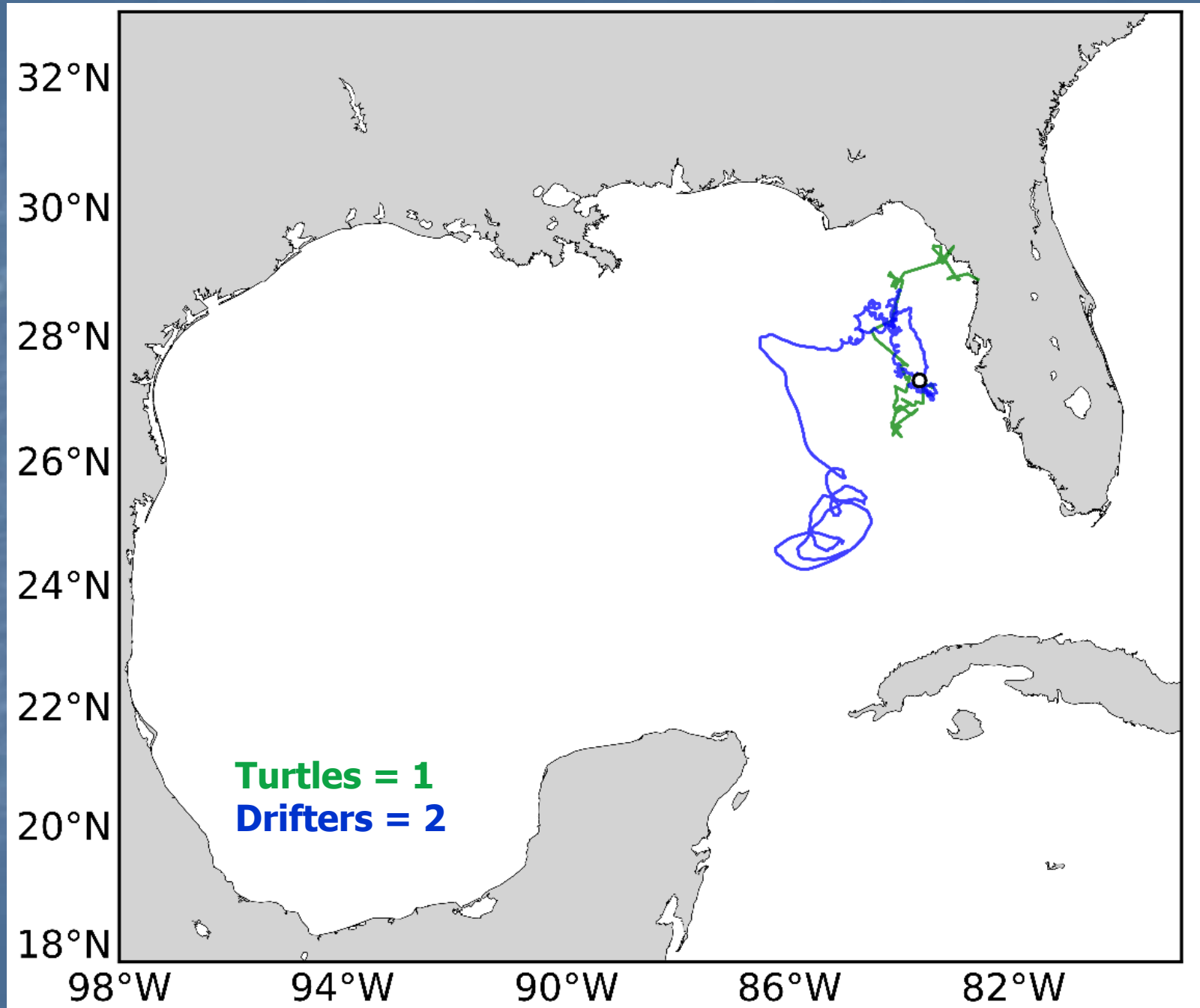




# Tracking results of turtles and drifters: release 5

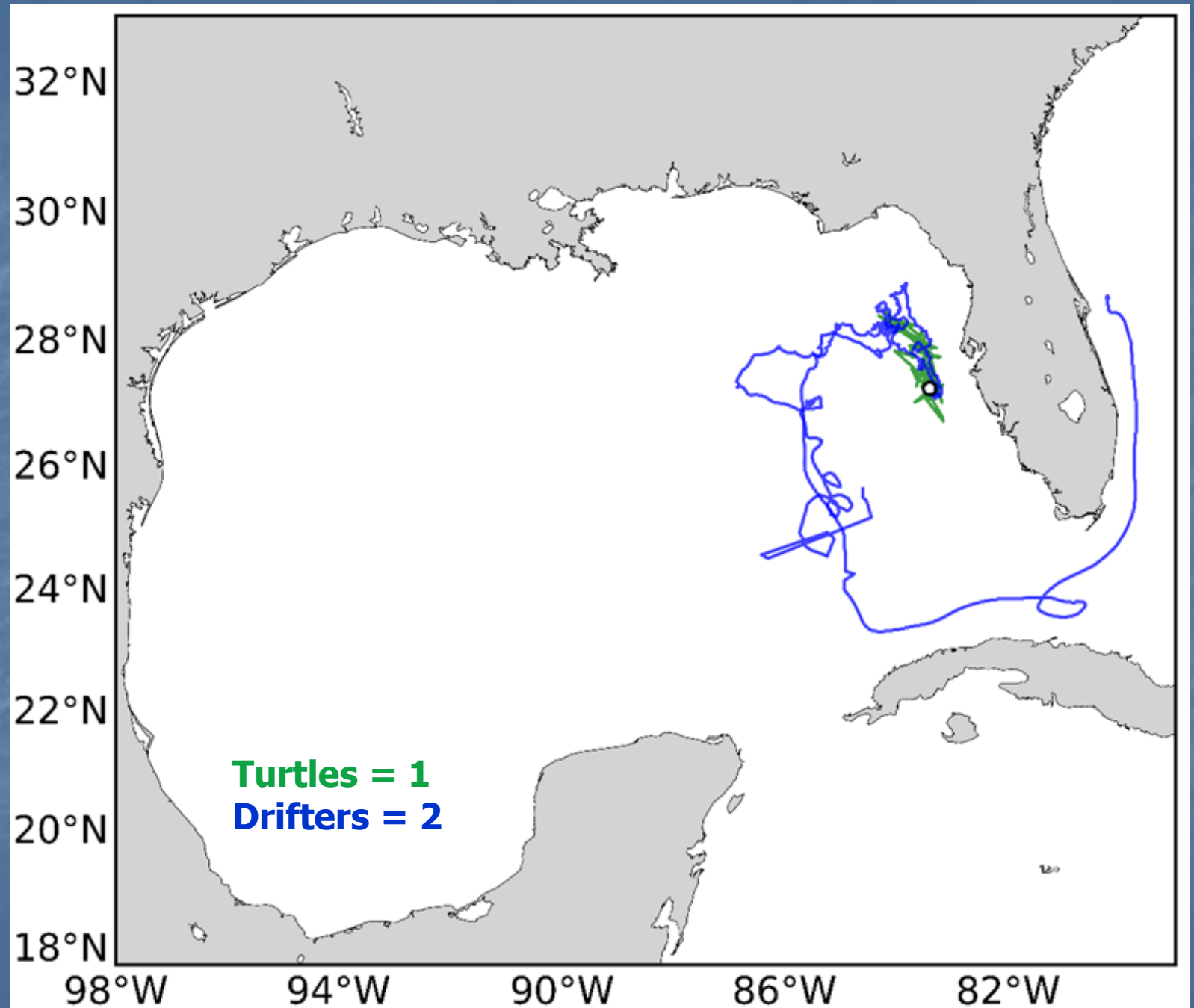


# Tracking results of turtles and drifters: release 6

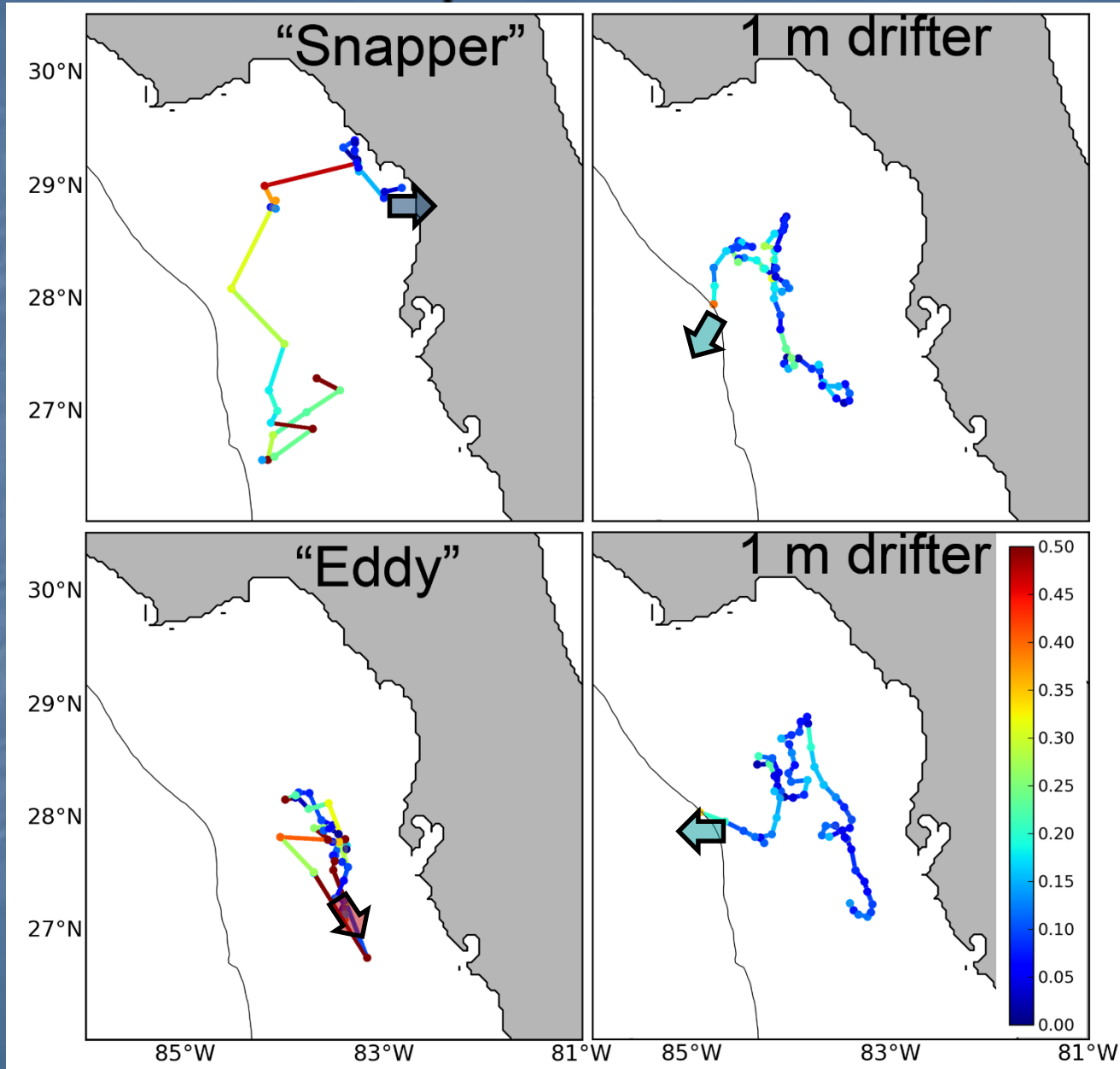




# Tracking results of turtles and drifters: release 7

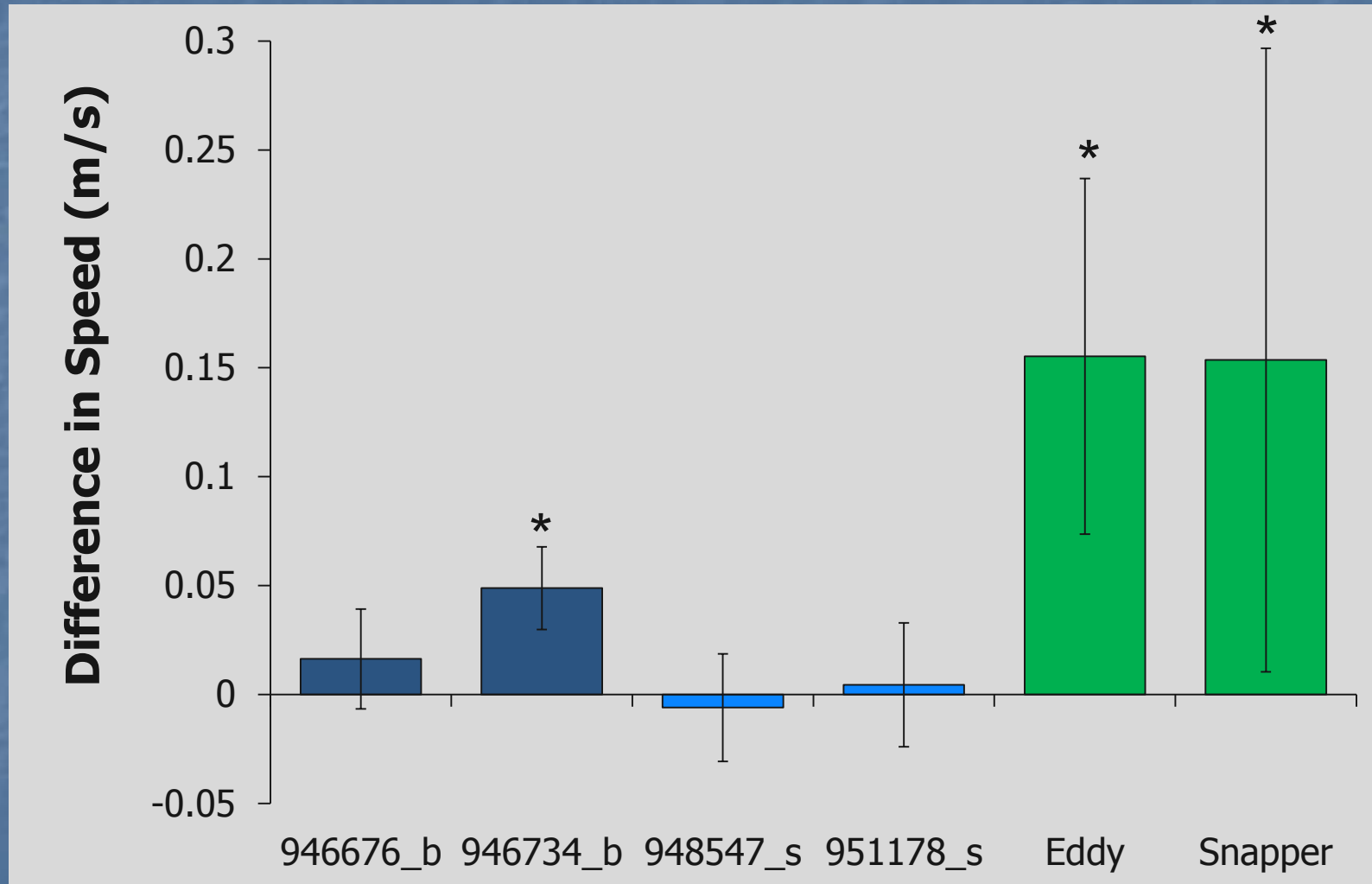


# Swim speed of turtles and drifters



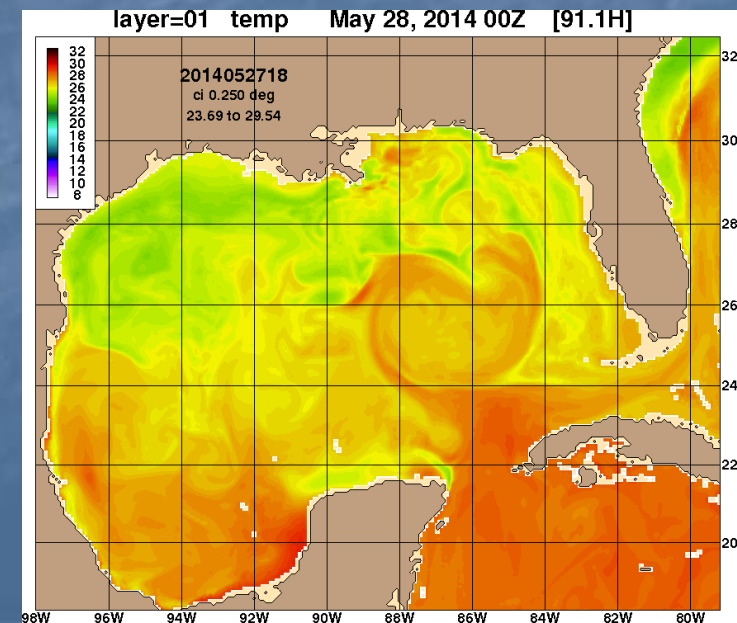
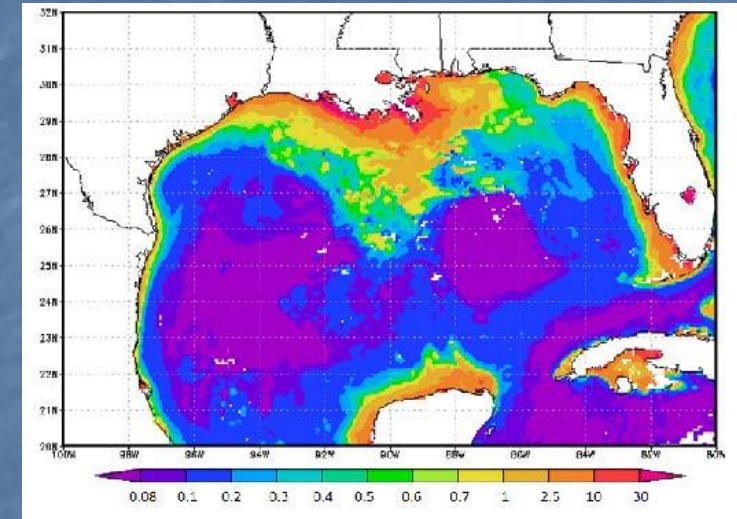
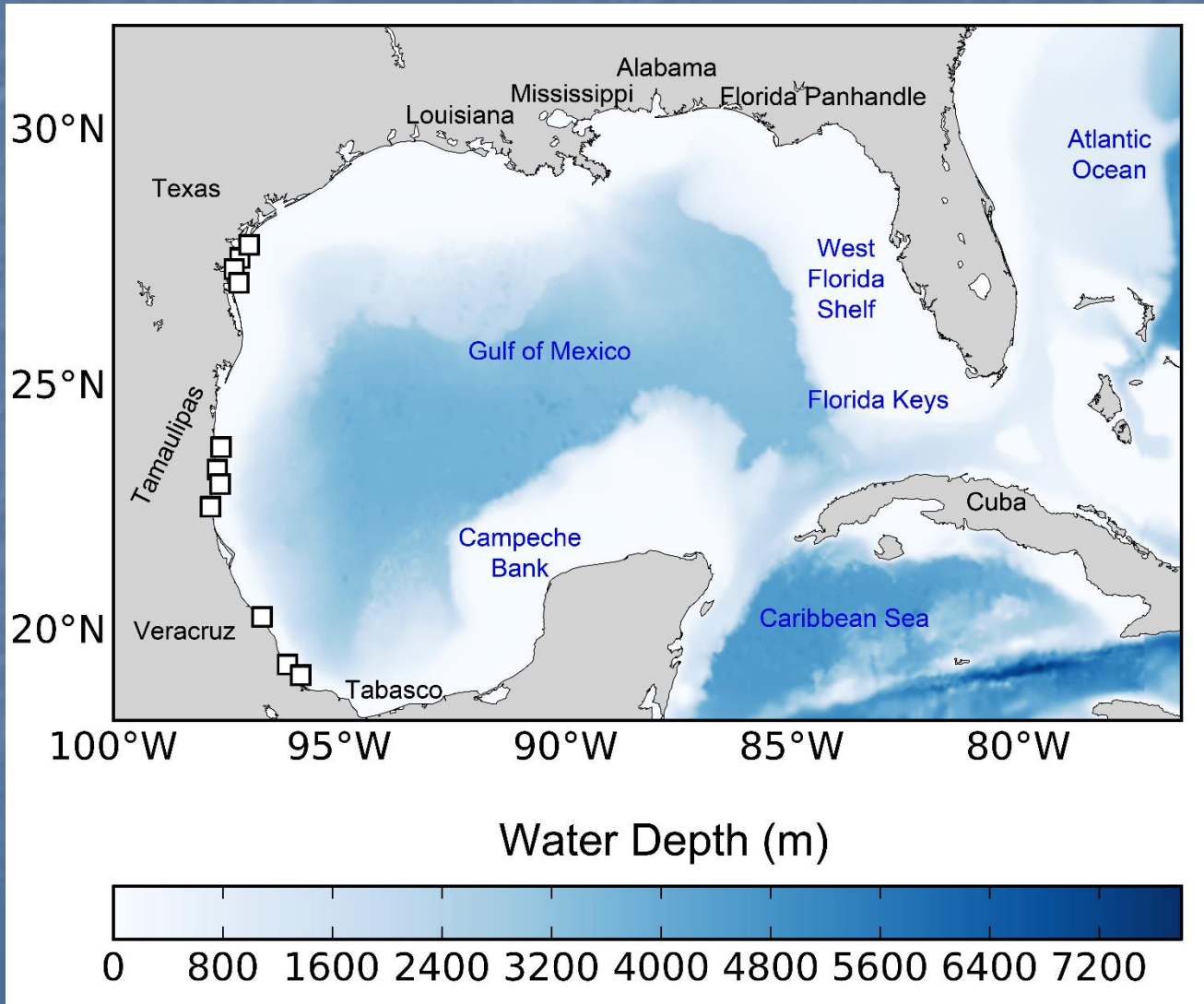


# Mean difference in velocity along the tracks of buoys and Kemp's ridley turtles relative to model



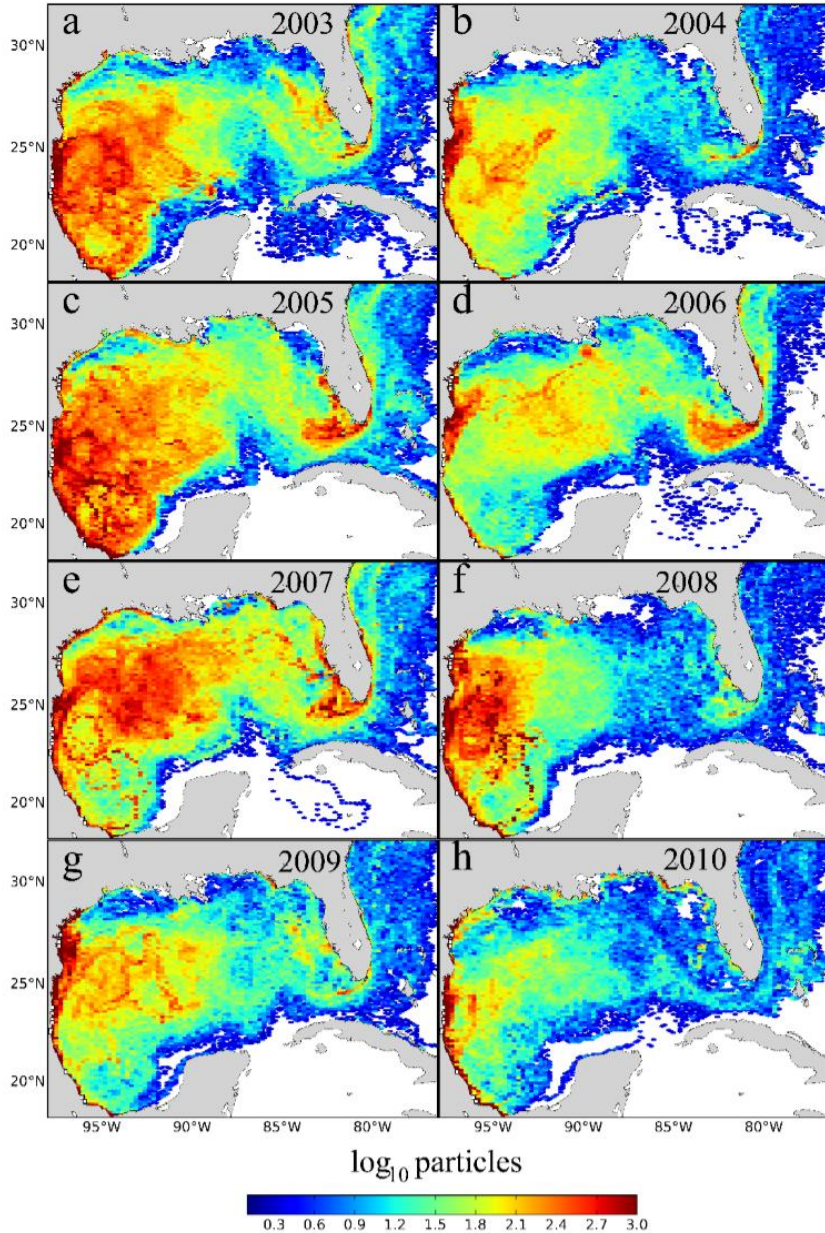
\* Indicates that track velocity is significantly faster than modeled surface current velocity (Wilcoxon Sign-Rank Tests,  $p \leq 0.038$ ).

# Relate movement patterns to environmental features to inform large-scale simulations of turtle movement patterns

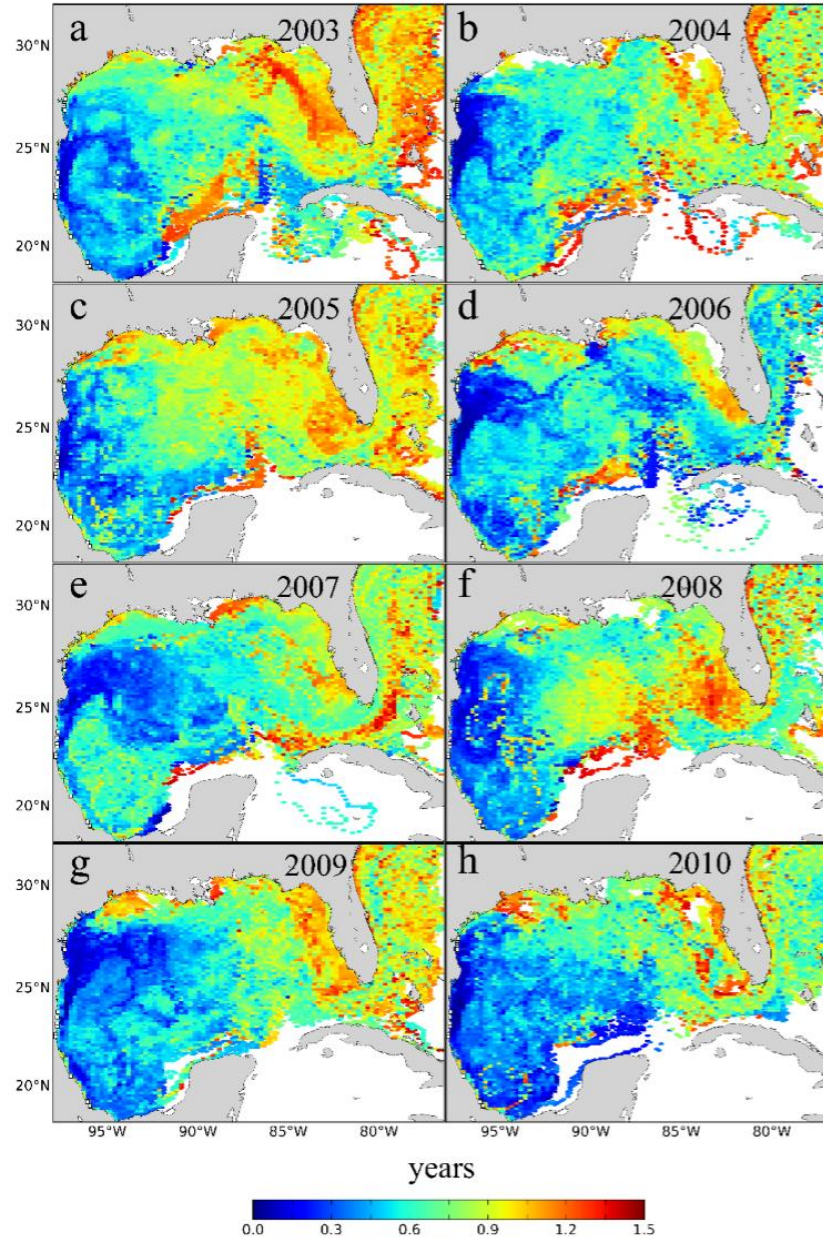




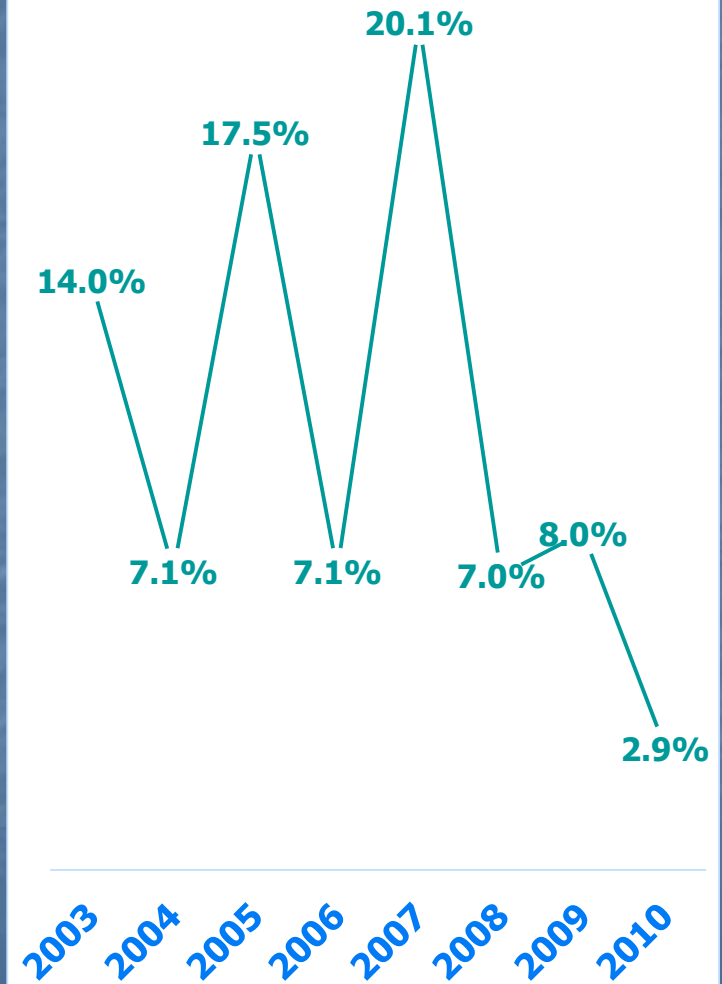
# Distribution



# Age-structure



# Survival





# Acknowledgements

## Useful People

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- Emily Putman
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